Key

1) A 17.5 mL sample of an acetic acid (CH_3CO_2H) solution required 29.6 mL of 0.250 M NaOH for neutralization. The concentration of acetic acid was _____ M.

weak acid

Strong base

Know: $CH_3CO_2H_{(aq)} + NaOH_{(aq)} \rightarrow NaCH_3CO_{2(aq)} + H_2O_{(l)}$

$V = 17.5\,mL$ $\quad V = 29.6\,mL$ $\quad M = \frac{0.250\,mol\,NaOH}{L}$

Want: $\frac{mol\,CH_3CO_2H}{L\,sol'n}$

(a) Det. $mol\,CH_3CO_2H$

$$29.6\,mL \times \frac{0.250\,mol\,NaOH}{L\,sol'n} \times \frac{1\,L}{1000\,mL} \times \frac{1\,mol\,CH_3CO_2H}{1\,mol\,NaOH} = 7.40\times10^{-3}\,mol\,CH_3CO_2H$$

(b) Det. $L\,sol'n$

$$17.5\,mL \times \frac{1\,L}{1000\,mL} = 0.0175\,L\,sol'n$$

(c) Det. M

$$\frac{7.40\times10^{-3}\,mol\,CH_3CO_2H}{0.0175\,L\,sol'n} = \boxed{0.423\,M\,CH_3CO_2H}$$

2) How many milliliters of 0.132 M $HClO_4$ solution are needed to neutralize 50.00 mL of 0.0789 M NaOH?

strong base strong acid

Want: $mL\,HClO_4$

Know: $HClO_{4(aq)} + NaOH_{(aq)} \rightarrow NaClO_{4(aq)} + H_2O_{(l)}$

$M = \frac{.132\,mol\,HClO_4}{L\,sol'n}$ $\quad V = 50.0\,mL$ $\quad M = \frac{0.0789\,mol\,NaOH}{L\,sol'n}$

(a) Det. moles NaOH → mol $HClO_4$

$$50.0\,mL \times \frac{0.0789\,mol\,NaOH}{L\,sol'n} \times \frac{1\,L}{1000\,mL} \times \frac{1\,mol\,HClO_4}{1\,mol\,NaOH} = 3.945\times10^{-3}\,mol\,HClO_4$$

(b) Det. Volume $HClO_4$

$$3.945\times10^{-3}\,mol\,HClO_4 \times \frac{L\,sol'n}{.132\,mol\,HClO_4} \times \frac{1000\,mL}{1\,L} = \boxed{29.9\,mL\ HClO_4\ sol'n}$$

3) Calculate the concentration (M) of sodium ions in a solution made by diluting 50.0 mL of a 0.874 M solution of sodium sulfide to a total volume of 250.0 mL.

Want: $\frac{mol\,Na^+}{L\,sol'n}$

Know: Na_2S $\quad V = 50.0\,mL$ $\quad V = 250.0\,mL$ $\quad M_1 = 0.874\,M$

(a) Determine M_{Na_2S} of dilute sol'n $\quad M_1V_1 = M_2V_2$

$$M_2 = \frac{M_1V_1}{V_2} = \frac{(0.874\,M)(50.0\,mL)}{(250.0\,mL)} = 0.1748\,M\,Na_2SO_4$$

(b) Det. M_{Na^+}

$$\frac{0.1748\,mol\,Na_2S}{L\,sol'n} \times \frac{2\,mol\,Na^+}{1\,mol\,Na_2S} = 0.3496 = \boxed{0.350\,M\,Na^+}$$